

Claims

- [c1] 1. A catalytic partial oxidation processor comprising:
 - a shell having an inlet for receiving a flow of heat exchange fluid and an outlet for discharging the flow of heat exchange fluid; and
 - at least one catalytic partial oxidation reactor disposed in the shell such that heat from partial oxidation in the at least one catalytic partial oxidation reactor transfers from the at least one catalytic partial oxidation reactor to the heat exchange fluid in the shell.
- [c2] 2. A catalytic partial oxidation processor as in claim 1 further comprising a plurality of catalytic partial oxidation reactors including the at least one catalytic partial oxidation reactor, the plurality of catalytic partial reactors disposed in the shell such that heat from partial oxidation in the plurality of catalytic partial oxidation reactors transfers from the plurality of catalytic partial oxidation reactors to the heat exchange fluid in the shell.
- [c3] 3. A catalytic partial oxidation processor comprising:
 - a shell having a heat exchange fluid inlet for receiving a flow of heat exchange fluid and a heat exchange fluid outlet for discharging the flow of heat exchange fluid;

at least one reactor tube disposed in the shell and having a hydrocarbon fuel inlet for receiving a feed gas mixture comprising a hydrocarbon fuel and an oxygen containing gas and an exit gas stream outlet for discharging an exit gas stream comprising the mixture of hydrogen and carbon monoxide, the at least one reactor tube forming a reaction flow passage extending from the hydrocarbon fuel inlet to the exit gas stream outlet and a catalytic reaction zone between the hydrocarbon fuel inlet and the exit gas stream outlet; and

a catalytic structure disposed in the catalytic reaction zone of the at least one reactor tube and comprising an oxidation catalyst for catalyzing a partial oxidation reaction of the feed gas mixture to form the exit gas stream; so that when the feed gas mixture is fed through the hydrocarbon fuel inlet, said feed gas mixture passes along the reaction flow passage and through said catalytic structure, said feed gas mixture converts in the catalytic structure to the exit gas stream, the exit gas stream discharges through the outlet, and heat from the partial oxidation reaction transfers from the at least one reaction tube to the heat exchange fluid in the shell.

[c4] 4. A catalytic partial oxidation processor as in claim 3, wherein the oxidation catalyst is a noble metal.

- [c5] 5. A catalytic partial oxidation processor as in claim 3, wherein the shell extends from one end to another and the at least one reaction tube extends from the one end to the other end.
- [c6] 6. A system for producing electric power comprising:
 - a shell having an inlet for receiving a flow of heat exchange fluid and an outlet for discharging the flow of heat exchange fluid;
 - at least one catalytic partial oxidation reactor for the catalytic partial oxidation of heavy hydrocarbon fuel to produce an exit gas stream containing hydrogen and carbon monoxide as main reaction products, the at least one catalytic partial oxidation reactor disposed in the shell such that heat from partial oxidation in the at least one catalytic partial oxidation reactor transfers from the at least one catalytic partial oxidation reactor to the heat exchange fluid in the shell; and
 - a fuel cell disposed for receiving the exit gas stream and consuming the hydrogen to produce electric power.
- [c7] 7. A method for the catalytic partial oxidation of hydrocarbon fuel comprising:
 - feeding a feed gas mixture comprising an oxygen containing gas and a hydrocarbon fuel through at least one catalytic partial oxidation reactor disposed in a shell;
 - reacting the feed gas mixture in the at least one catalytic

partial oxidation reactor in the presence of an oxidation catalyst to convert the feed gas mixture to an exit gas mixture of hydrogen and carbon monoxide; and passing a heat exchange fluid through the shell and past the at least one catalytic partial oxidation reactor with the heat exchange fluid in the shell flowing in the same direction of reactant flow in the catalytic partial oxidation reactor tube such that heat from partial oxidation in the at least one catalytic partial oxidation reactor transfers from the at least one catalytic partial oxidation reactor to the heat exchange fluid in the shell.

- [c8] 8.A method as in Claim 7, wherein the hydrocarbon fuel is a heavy hydrocarbon fuel.
- [c9] 9.A method as in Claim 8, wherein said heavy hydrocarbon fuel comprises a plurality of hydrocarbon molecules, with substantially all of said molecules each containing at least 6 carbon atoms.
- [c10] 10.A method as in Claim 8, wherein said heavy hydrocarbon fuel is selected from the group consisting of gasoline, kerosene, jet fuel, and diesel fuel.
- [c11] 11.A method as in Claim 7, wherein said oxidation catalyst is a noble metal.
- [c12] 12.A method as in Claim 7, wherein the partial oxidation

reaction is maintained at a temperature greater than about 900°C.

- [c13] 13. A method for producing electric power comprising the steps of:
 - feeding a feed gas mixture comprising an oxygen containing gas and a hydrocarbon fuel through at least one catalytic partial oxidation reactor disposed in a shell;
 - reacting the feed gas mixture in the at least one catalytic partial oxidation reactor in the presence of an oxidation catalyst to convert the feed gas mixture to an exit gas mixture of hydrogen and carbon monoxide;
 - passing a heat exchange fluid through the shell and past the at least one catalytic partial oxidation reactor with the heat exchange fluid in the shell flowing in the same direction of reactant flow in the catalytic partial oxidation reactor tube such that heat from partial oxidation in the at least one catalytic partial oxidation reactor transfers from the at least one catalytic partial oxidation reactor to the heat exchange fluid in the shell; and
 - directing said exit gas mixture to said solid oxide fuel cell system.
- [c14] 14. A method as in Claim 13, wherein the hydrocarbon fuel is a heavy hydrocarbon fuel.
- [c15] 15. A method as in Claim 14, wherein said heavy hydro-

carbon fuel comprises a plurality of hydrocarbon molecules, with substantially all of said molecules each containing at least 6 carbon atoms.

- [c16] 16. A method as in Claim 14, wherein said heavy hydrocarbon fuel is selected from the group consisting of gasoline, kerosene, jet fuel, and diesel fuel.
- [c17] 17. A method as in Claim 13, wherein said oxidation catalyst is a noble metal.
- [c18] 18. A method as in Claim 13, wherein the partial oxidation reaction is maintained at a temperature greater than about 900°C.